Response to comments from Anonymous Referee #1

Thank you for your positive and constructive comments on our submitted manuscript. Below you find a point-by-point response to each of the comments and revisions suggested. The line numbers refer to the original preprint version that you reviewed.

- Referee comments are in black color.
- **Replies to referee comments are in blue.**
- **The new paragraphs, sentences or words added to the manuscript are underlined and in orange.**

Overview:

This manuscript presents new d2Hwax data from soils, river and marine sediments along the Chilean coast. The results show that there is a constant apparent fractionation in humid regions, whereas in arid regions evapotranspiration contributes to the d2Hwax signal. The d2Hwax of C29/C31 is shown to also be related to the aridity gradient, and potentially can reflect vegetation type changes. d2Hwax of marine sediments reflect the terrestrial d2Hwax input.

Review:

This manuscript is very interesting, provides novel data and important global insights and is structured and written very well. I congratulate the authors for a well-presented paper. The MS presents novel and systematic data, combined with a wide array of global databases (climate, vegetation etc.) and an updated d2Hwax database. The manuscript is particularly interesting in its assessment of the evaporation effect on d2Hwax in arid regions, and provides a global perspective on this process. The modeling and model parametrization are explained very well and lay out the method for utilizing this method in other places.

I recommend publishing the paper pending some minor and textual comments.

Thank you for the appreciation of our work.

Minor:

L116. Please explain how you calculate the uncertainty of the d2H values (e.g., average of duplicates? long-term error? error of the A6? etc..).

Thanks for bringing this to our attention. To bring more clarity for the readers we added the following sentence to the line 116 of the manuscript: The uncertainty of the δ^2H_{wax} values was calculated using the standard deviation between the duplicate measurements of each sample.

L297. This correlation is for soils and lakes combined?

The correlation mentioned in this line is indeed for soils and lakes combined, as it is also stated in the column 'sediment type' in table 2. To make this clearer we added a description at the table bottom to clarify what 'sediment type' refers to. Additionally , we

added the following phrase at line 297 of the manuscript: <u>combining the lakes and soils data</u>,

L350. Why not present the annual average from each site compared to the OIPC data? Or, maybe just average the growing season months? In addition, it would be useful if you could provide the average residuals and standard deviation of the residuals (what is the difference between measured and OIPC data in permil).

Thank you for this comment and for the suggestions. We agree that the idea of presenting the annual average is sensible and have implemented this and added a new analysis and a figure to the supplement (Figure S1.C), where we compare the mean annual values of each GNIP site compared to the mean annual prediction of the OIPC. We also added a table (Table S2.1) in the supplement showing the average residuals and standard deviation of the residuals for each of the analysis.

Regarding the growing season months, we decided to not pursue this type of analysis in our study due to the added complexity and uncertainty that would come from defining accurate growing season months along our study area. It has been shown that plants along the Chilean climatic gradient have different timings of the growing season (Hajek & Gutiérrez, 1979), and even within the same catchment areas it is expected that plants in the upper regions of the catchments will have different growing season months than plants in the lower regions (Arroyo et al., 1981). Consequently, in our study area, it is not correct to define some unique months of the year as the growing season. Instead, to pursue this type of analysis, multiple growing seasons should be defined along the gradient and even be considered inside each catchment. We understand that eventually defining multiple growing seasons may be more precise, but we believe that the added uncertainties would not be justified. Therefore, we decided to avoid these added uncertainties and used the mean annual OIPC value for our catchments and sampling sites which encompasses an average signal that would be integrated by the plants of our study areas.

L498 – 519. The statistical test shows that the marine, river and soils d2H overlap and are not statistically different from one another. However, Fig. 7 shows that marine sediments are, on average, heavier from rivers and soils and don't really overlap at the 1 sigma level. Is this of importance? The Peru current flows northward, so ocean mixing would cause the opposite effect. Maybe higher contribution from coastal sediments (that should be heavier than the rivers based on Fig. 1c)?

We thank the reviewer for the thoughtful comment. Certainly Fig. 7 visually indicates that heavier δ^2H_{wax} values were measured in marine sediments in comparison to soils and river sediments. We acknowledge that this may suggest that marine sediments have a different source than the soils and river sediments of their respective aridity zone. However, the statistical test performed indicates that median δ^2H_{wax} values are not statistically different among the different sediment types measured. This suggests that, although the values might be marginally higher in marine sediments, the difference is not significant.

However, we accept that it could be a valuable insight for some readers, thus we included the following paragraph discussing this observation at line 520: <u>In Fig. 7, δ^2H_{wax} values from marine sediments generally display higher δ^2H_{wax} values in marine sediments in</u>

comparison to soils and river sediments. Although the difference between δ^2H_{wax} values among the sediment types is not statistically significant, higher δ^2H_{wax} values in marine sediments might be attributed to differences in sourcing and transport of the continental sediments. However, given the limited sample set of paired marine and river sediments in the arid region and the absence of statistically significant differences in δ^2H_{wax} values between the sediment types, we consider further discussion would be too speculative at this point.

Textual comments:

L33. Add the abbreviation d2H_{wax} (instead of line 37)

As suggested, we added the abbreviation in line 33 instead of line 37.

L65. Notation d13C X2

The notation was accordingly corrected.

L112. Notation H3+

The notation was corrected.

L181. The wording here is not so clear (what is the purpose of this test? Testing the similarity of two populations?). Can you please rephrase.

Thank you for bringing this to our attention. The goal of the Kruskal-Wallis test is to statistically test the hypothesis that the medians of two or more groups are similar. If the p-value of the test is <0.05 this hypothesis must be rejected, indicating a statistically significant difference between the medians of the groups. Being a non-parametric method, it does not make any assumptions about the distribution of the data, and using the median helps to avoid errors induced by outliers in the data. This gives robustness to the test and makes it applicable to our case.

To add clarity in our manuscript we rephrased the paragraph starting at line 182: The Kruskal-Wallis test was used to statistically test the hypothesis that the median δ^2H_{wax} values are similar among the different aridity zones and sediment types. This non-parametric test does not make any assumptions about the distribution of the data, and using the median instead of the mean helps to avoid errors induced by outliers in the data. If the p-value of the test is <0.05, then the null hypothesis must be rejected, indicating a statistically significant difference between the medians of the groups (Kruskal & Wallis, 1952). We performed the test using the function *kruskal.test()* of the *stats* package version 4.2.1 from the R programming language (R Core Team, 2022).

L198. Reference format

The reference format was corrected.

L199. missing “back to isotopic ratios”

This was added as suggested.

L273. Table 1 - IGSN not defined

International Geo Sampling Number (IGSN) was defined at the bottom of the table.

Table 2. df, is this the same as the number of samples used for the regression? If so, I think number of samples is a more straightforward definition of this.

df means degrees of freedom, which is the number of independent observations (samples) minus the number of parameters estimated by the model. Since our linear regression model estimates the parameters slope and intersect, then it is the number of samples minus 2. To add clarity, we added a column called 'number of samples' and also added a definition of df at the table bottom.

L475. Should be 'explained' not 'exposed'

This was changed as suggested.

L547. Maybe 'also' instead of 'more strongly'

This was changed to 'additionally'.

References:

Arroyo, M. T. K., Armesto, J. J., & Villagran, C. (1981). Plant phenological patterns in the high Andean Cordillera of central Chile. *The Journal of Ecology*, 205–223.

Bernhardt, A., Hebbeln, D., Regenberg, M., Lückge, A., & Strecker, M. R. (2016). Shelfal sediment transport by an undercurrent forces turbidity-current activity during high sea level along the Chile continental margin. *Geology*, *44*(4), 295–298.

Hajek, E. R., & Gutiérrez, J. (1979). Growing seasons in Chile: Observation and prediction. *International Journal of Biometeorology*, *23*, 311–329.

Kruskal, W. H., & Wallis, W. A. (1952). Use of ranks in one-criterion variance analysis. *Journal of the American Statistical Association*, *47*(260), 583–621.

Pizarro, O., Shaffer, G., Dewitte, B., & Ramos, M. (2002). Dynamics of seasonal and interannual variability of the Peru-Chile Undercurrent. *Geophysical Research Letters*, *29*(12), 22–1.

R Core Team, R. (2022). *R: A language and environment for statistical computing*. https://www.R-project.org/.